

mh_random_walk.R

sahluwalia

2020-06-14

```
lg = function(mu, n, ybar) {  
  mu2 = mu^2  
  n * (ybar * mu - mu2 / 2.0) - log(1 + mu2)  
}  
  
mh = function(n, ybar, n_iter, mu_init, cand_sd) {  
  ## Random-Walk Metropolis-Hastings algorithm  
  
  ## step 1, initialize  
  mu_out = numeric(n_iter)  
  accpt = 0  
  mu_now = mu_init  
  lg_now = lg(mu=mu_now, n=n, ybar=ybar)  
  
  ## step 2, iterate  
  for (i in 1:n_iter) {  
    ## step 2a  
    mu_cand = rnorm(n=1, mean=mu_now, sd=cand_sd) # draw a candidate  
  
    ## step 2b  
    lg_cand = lg(mu=mu_cand, n=n, ybar=ybar) # evaluate log of g with the candidate  
    lalpha = lg_cand - lg_now # log of acceptance ratio  
    alpha = exp(lalpha)  
  
    ## step 2c  
    u = runif(1) # draw a uniform variable which will be less than alpha with probability min(1, alpha)  
    if (u < alpha) { # then accept the candidate  
      mu_now = mu_cand  
      accpt = accpt + 1 # to keep track of acceptance  
      lg_now = lg_cand  
    }  
  
    ## collect results  
    mu_out[i] = mu_now # save this iteration's value of mu  
  }  
  
  ## return a list of output  
  list(mu=mu_out, accpt=accpt/n_iter)  
}
```

```

y = c(1.2, 1.4, -0.5, 0.3, 0.9, 2.3, 1.0, 0.1, 1.3, 1.9)
ybar = mean(y)
n = length(y)
hist(y, freq=FALSE, xlim=c(-1.0, 3.0)) # histogram of the data
curve(dt(x=x, df=1), lty=2, add=TRUE) # prior for mu
points(y, rep(0,n), pch=1) # individual data points
points(ybar, 0, pch=19) # sample mean

set.seed(1989) # set the random seed for reproducibility
post = mh(n=n, ybar=ybar, n_iter=1e3, mu_init=0.0, cand_sd=3.0)
str(post)

```

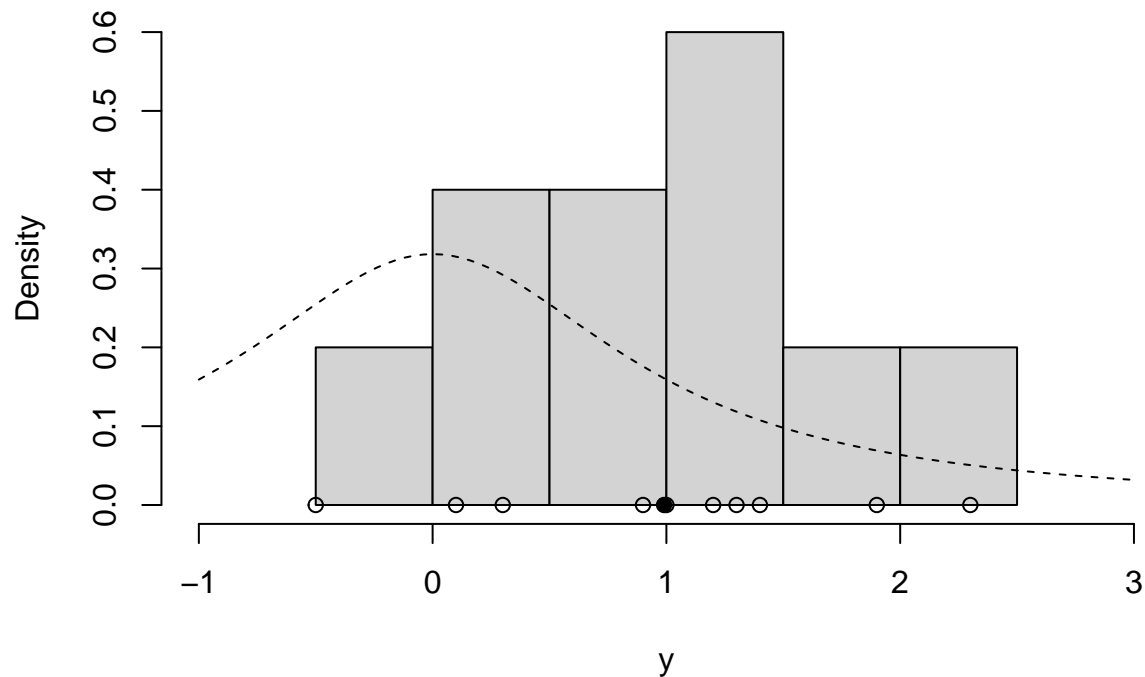
```

## List of 2
## $ mu : num [1:1000] 0 1.141 0.558 0.558 0.558 ...
## $ accpt: num 0.132

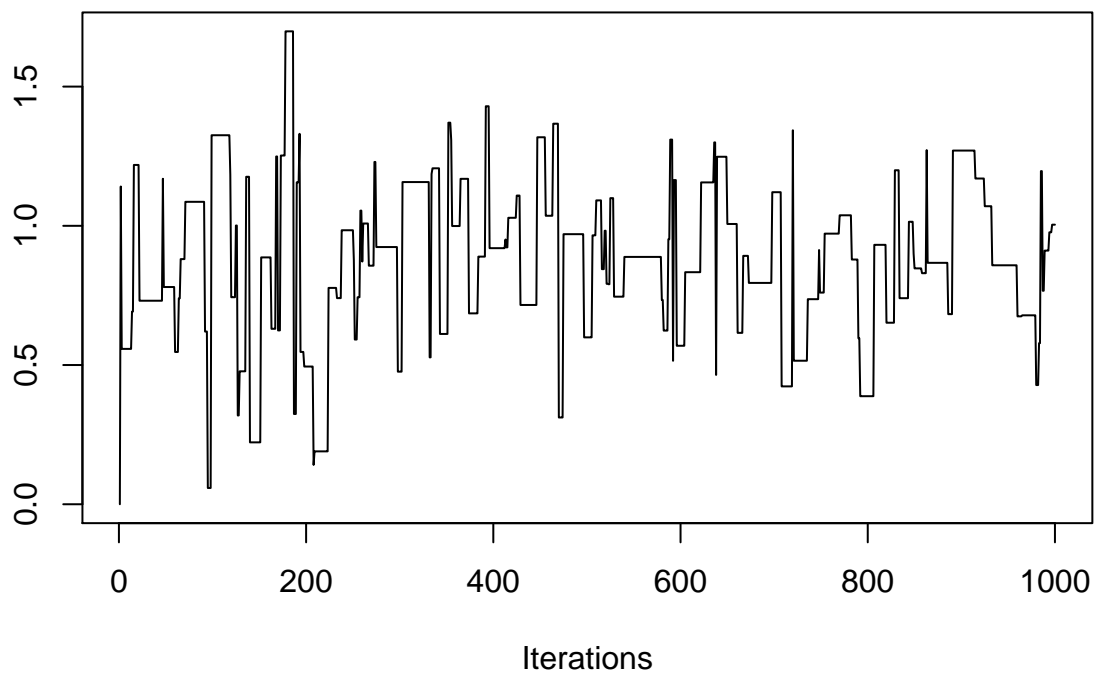
```

```
library("coda")
```

Histogram of y



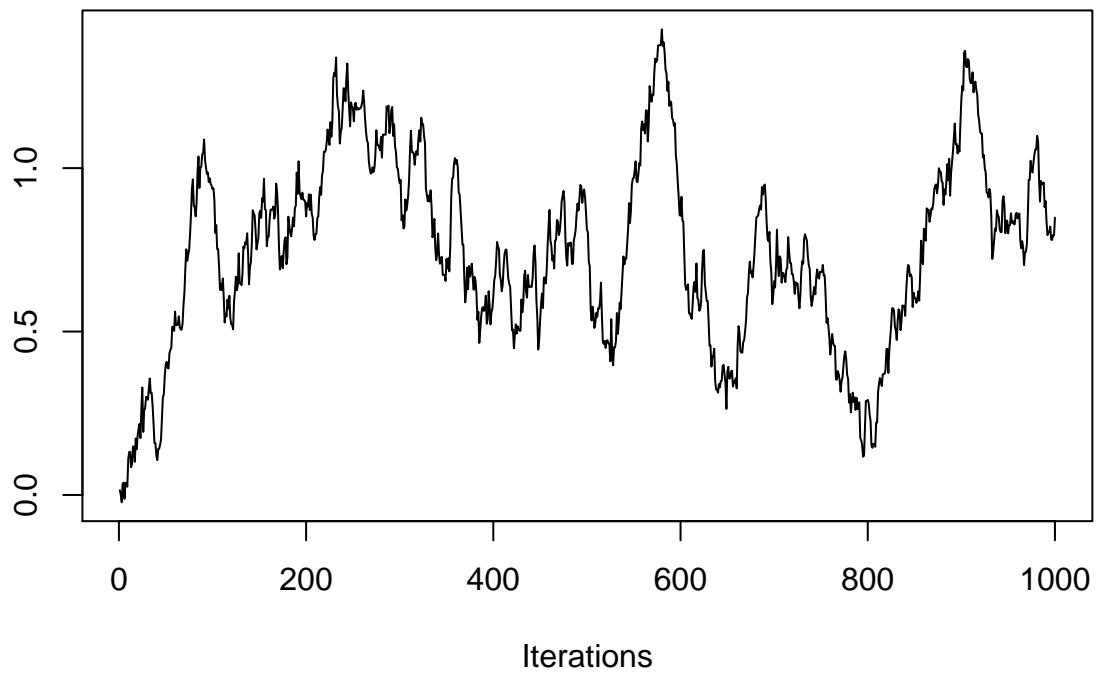
```
traceplot(as.mcmc(post$mu))
```



```
post = mh(n=n, ybar=ybar, n_iter=1e3, mu_init=0.0, cand_sd=0.05)
post$accept
```

```
## [1] 0.947
```

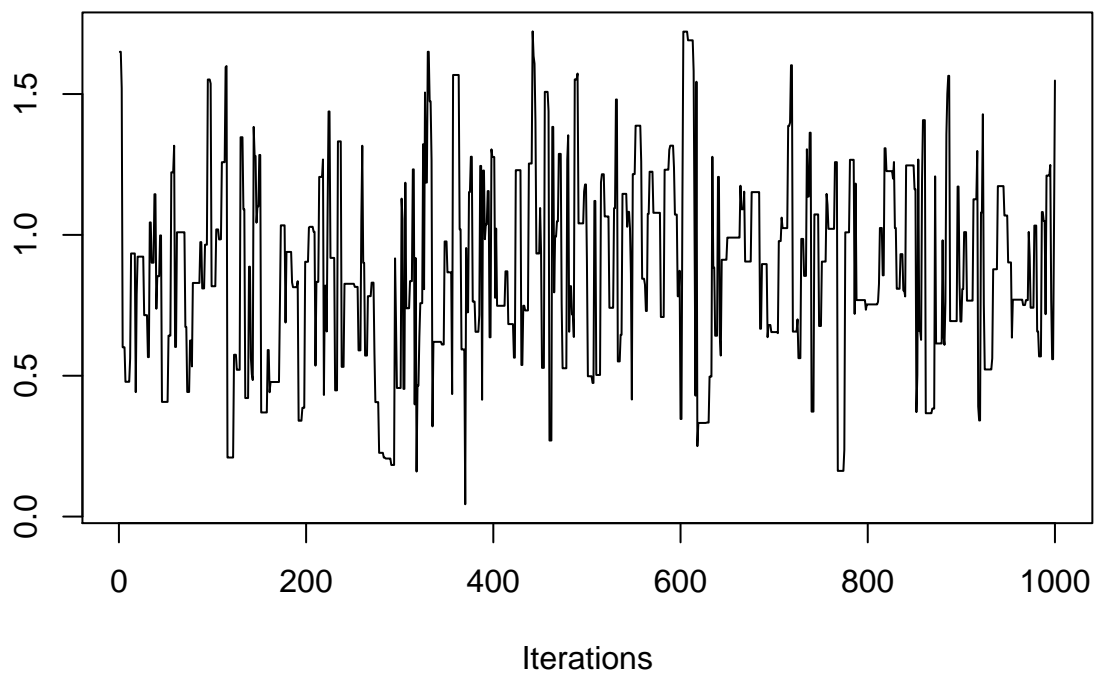
```
traceplot(as.mcmc(post$mu))
```



```
post = mh(n=n, ybar=ybar, n_iter=1e3, mu_init=0.0, cand_sd=0.9)
post$accept
```

```
## [1] 0.359
```

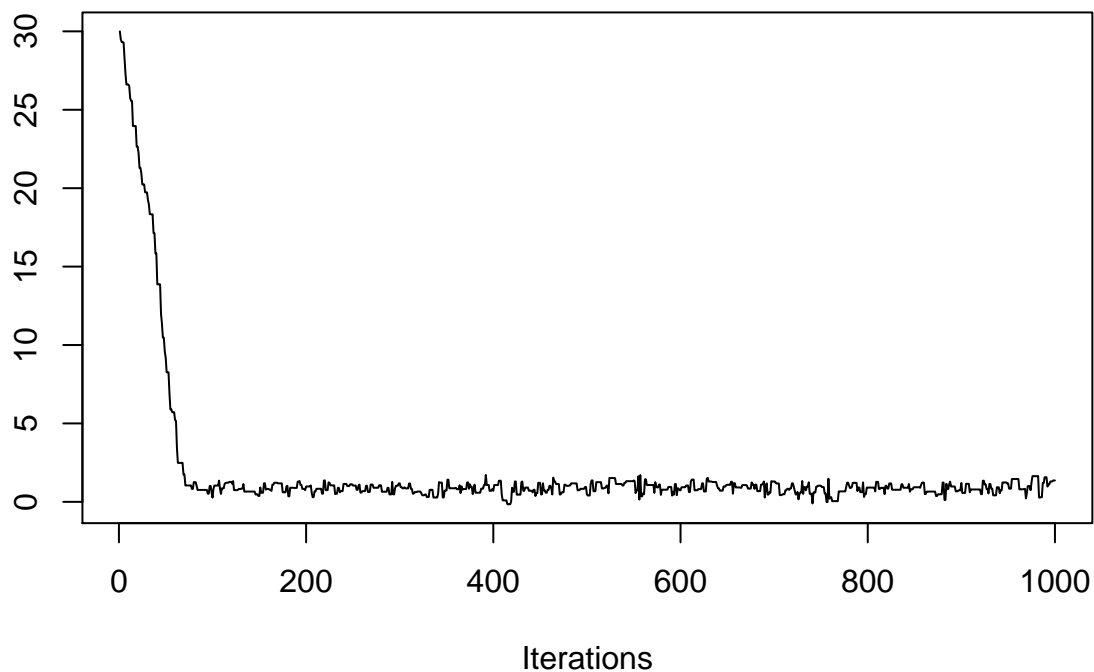
```
traceplot(as.mcmc(post$mu))
```



```
post = mh(n=n, ybar=ybar, n_iter=1e3, mu_init=30.0, cand_sd=0.9)
post$accept
```

```
## [1] 0.42
```

```
traceplot(as.mcmc(post$mu))
```



```
post$mu_keep = post$mu[-c(1:100)] # discard the first 200 samples
plot(density(post$mu_keep, adjust=2.0), main="", xlim=c(-1.0, 3.0), xlab=expression(mu)) # plot density
curve(dt(x=x, df=1), lty=2, add=TRUE) # prior for mu
points(ybar, 0, pch=19) # sample mean

curve(0.017*exp(lg(mu=x, n=n, ybar=ybar)), from=-1.0, to=3.0, add=TRUE, col="blue") # approximation to
```

